MANGALA VALLES PALEOLAKE LANDING SITE. K. .L. Tanaka and M. G. Chapman; US Geological Survey, 2255 N. Gemini Drive, Flagstaff, AZ 86001 (ktanaka@flagmail.wr.usgs.gov).

Introduction: Mangala Valles (see Fig. 1) is an outflow channel system about 850 km long and as much as 300 km wide that cuts the equatorial martian highlands. The channel system originates at one of the northeast-trending Memnonia Fossae graben and ends at the highland-lowland boundary scarp. The debouchment area on Amazonis Planitia extends from lat 4° S. to at least lat 2.5° N. Mangala Valles channel-floor deposits offer grab-bag collection areas as do most of the outflow channels. The channel has ponded areas where floods have accumulated over long periods, similar to Ma'adim Vallis and Gusev crater. The unique and compelling characteristics of Mangala Valles for lander investigations are that it (1) heads at a likely source of thermal water; (2) includes both lava flows and flood deposits; (3) contains areas where water ponded; (4) is mostly covered by high-resolution Viking imagery (<50 m/pixel); and (5) has had detailed 1:500,000-scale geologic maps produced for nearly the entire channel system.

Numerous sites of high scientific interest occur along the length of the Mangala Valles channel system. We propose the floor of a 45-km-diameter impact crater breached by a branch of Mangala Valles for the Mars '01 Lander site (centered at lat 6.3° S., long 153.2°). The crater floor possibly includes material deposited within paleolakes.

Site Characteristics: The landing ellipse could be safely located within the 45-km-diameter smooth floor of the impact crater (Fig. 1). In this region, MOLA data indicate that the elevation ranges from about –2 to 0 km [1]. The crater floor is marked by a few broad, low ridges (all surface slopes are likely to be much less than 10°). The site has a moderate rock abundance (between 5-7%) and an elevation of about 2 km above datum, but fine-component thermal inertia values are a bit low (2.7 cgs units). However, observation of MOC images in other areas of low thermal inertia do not necessarily support the interpretation of abundant dust; therefore, low thermal inertia values should not necessarily preclude the Mangala site as a candidate 2001 landing area.

Site Geology: Detailed geologic mapping at 1:500,000 scale (Fig. 1) [2] indicates only one type of material crops out within the proposed landing ellipse—lacustrine material. This material likely includes rocks of many different origins and ages, because the crater floor was periodically covered by debris derived from various highland and lava-flow deposits during catastrophic-flood episodes. In addition, impact gardening would bring older material, possibly buried by later eolian deposition, to the surface. The lacustrine material was mapped as Amazonian-Hesperian smooth material (unit AHms) of the Mangala Valles assemblage emplaced within a Noachian impact crater. Water from each stage of two postulated catastrophic flood stages of Mangala Valles breached the impact crater lying in the path of the floods and flowed into the low-lying crater floor [2-3]. The decrease in stream energy of the floods as they entered the craters, as well as the possible development of temporary lakes [4] and eolian infilling, may explain the unit's smooth surface in Viking images. Outcrops near the landing site contain nested, semicircular ridges that decrease in circumference toward a breach of the crater's north rim. These ridges appear similar to paleoshoreline gravel ridges (not the well-known lake terraces) formed by wind and wave interaction during recession of ancient Lake Bonneville at Spring Valley, Utah [2].

Science Justification: A number of factors make the Mangala Valles site scientifically desirable, including:

(1) The search for life. Mangala Valles is a highly relevant area for exobiologic studies. Our site offers access to recent and ancient rocks that can be sectioned and examined for evidence of fossils. Hydrothermal systems are thought to have formed early habitats on Earth; sites that include materials resulting from hydrothermal activity are thus important targets in searching for martian fossils [5]. The Mangala channels may provide such a setting, because it emanates from a tectonic graben of Memnonia Fossae that is thought to have released thermal waters associated with Tharsis volcanism [3, 6]. Moreover, young channel deposits and lake beds are particularly important exobiologic targets, because recent water outflows may have exposed and deposited molecular evidence of extant life; also, ice-covered lakes might have been sites for life's "last stand" on the martian surface [7]. Some postulated channel and lacustrine deposits of Mangala Valles are as young as Amazonian [2, 3, 6, 8-10]. The proposed candidate 2001 site is within a crater thought to contain lacustrine deposits (Fig. 1) [2].

(2) Resource assessment. A lander investigation at our proposed site would sample martian crustal materials of various ages and origins. The catastrophic outflow channels of Mangala Valles cut across a complex region composed of rocks of Noachian highlands and of Hesperian to Amazonian volcanic and sedimentary terrains (Fig. 1).

(3) Geologic history. Understanding of crustal hydrothermal activity, volcanism, and sedimentary

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processes are primary geologic science goals for Mars missions [11]. Rocks at the proposed landing site record the flooding of both thermal waters and lava flows that emanated from a Memnonia Fossae graben [2, 6, 12].

(4) Volatile and climatic history. Formation of martian outflow channels has been attributed to catastrophic flooding [13], glacial erosion [14], and debris flows [15]. Investigation of the geomorphology, lithology, and rock distributions at the proposed site may elucidate the channeling and sedimentary processes and climate conditions when the deposits formed at the proposed lander site.

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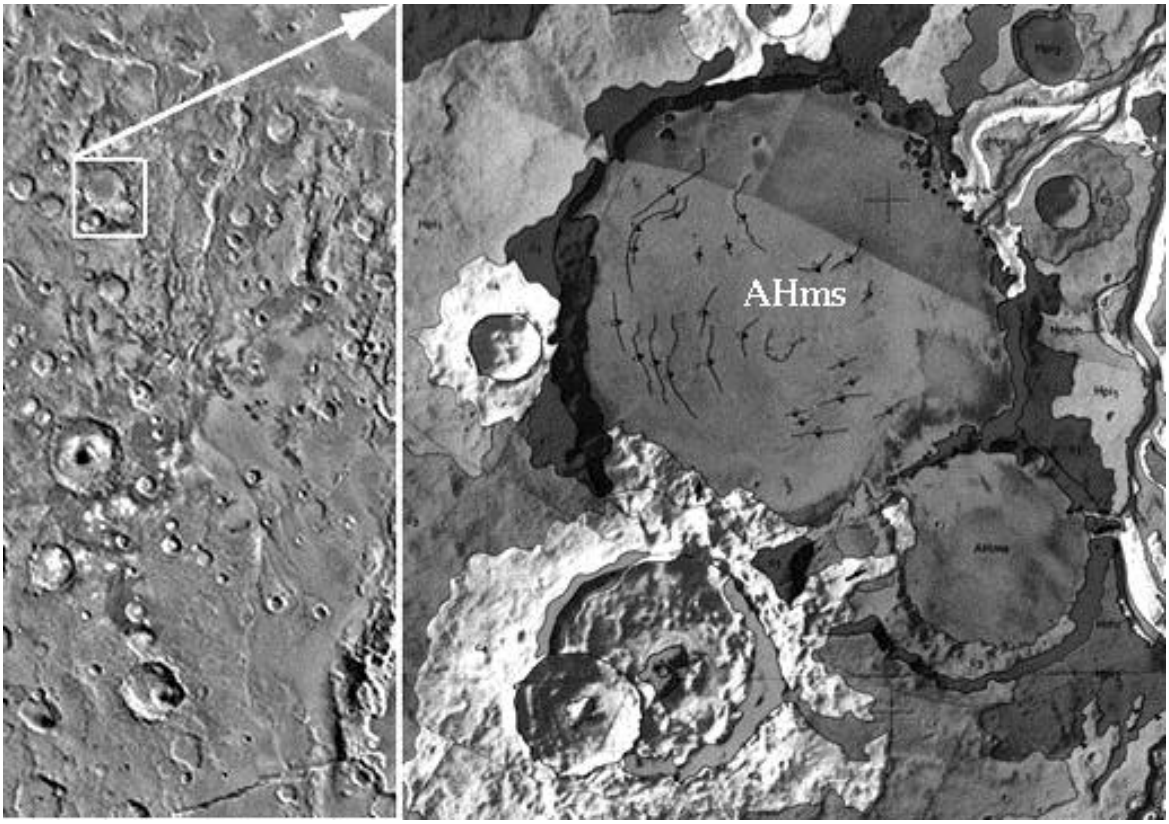

Figure 1. Mangala Valles region (left), showing full extent of the channel system from a linear graben system (bottom of image) to where it debouches into southern Amazonis Planitia (top). (Part of Mars Digital Image Mosaic; lat 18.5° S. to 2.5° N. and long 149° to 157°; north at top). White box shows location of area of geologic map on right (from [7]), which includes the 45-km-diameter floor of a Noachian crater, containing smooth material (unit AHms). Note that branches of Mangala Valles breach the right side of the adjacent, smaller (~20 km) crater to the lower right and the upper right side of the larger crater. Our proposed Mangala Valles site for the Mars ’01 lander is within the northern part of the larger crater where ridges are absent.